Exploring OpenROAD's Proficiency in RTL-to-GDS Implementation of a High-Speed On-Chip Serializer

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Abstract

This research paper presents the design and implementation of an on-chip digital 16:1 serializer using advanced 7nm FinFET technology. The serializer plays a crucial role in high-performance System-on-Chip (SoC) designs, enabling efficient and reliable data transmission. Leveraging the capabilities of OpenROAD, an automated and open-source tool for RTL to GDS design flow, the serializer's performance is optimized at the physical level. The implemented serializer achieves impressive results, including a power dissipation of 7.9 mW and a high-speed data transmission rate of 6.8 Gbps. Moreover, it occupies only 14% of the total chip area, allowing for significant integration with other system blocks and reducing the number of on-chip pins. This research presents a compelling demonstration of the remarkable efficacy of OpenROAD, combined with the cutting-edge 7nm FinFET technology, in achieving unparalleled levels of performance, integration, and compatibility in on-chip digital serializer designs.

Keywords: RTL-to-GDS flow, On-chip serializer, OpenROAD, 7nm technology node, VLSI design, Electronic design automation (EDA), Open-source tools

1. Introduction

Efficient serializer design is crucial in modern electronic systems as it enables high-speed data transmission while minimizing power consumption[1]. Serializers play a vital role in converting parallel data streams into serial data, facilitating efficient communication over limited bandwidth channels[2]. Achieving optimized serializer designs requires addressing factors such as data rate, power consumption, and area utilization. Various techniques and optimization methods have been proposed in existing literature to tackle these challenges. This research paper aims to explore the significance of efficient serializer design and present a detailed case study showcasing effective strategies and techniques for achieving optimized serializer designs.

The OpenROAD project, an open-source tool for digital integrated circuit design, offers a comprehensive suite of tools that streamline the RTL to GDS flow[3]. OpenROAD incorporates advanced algorithms for placement, routing, optimization, and timing closure,

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providing designers with a seamless platform to translate their RTL designs into physical layouts. By leveraging the capabilities of OpenROAD, this research paper aims to implement a serializer design and analyze its performance in terms of metrics such as power consumption, area utilization, and other relevant factors. The integration of OpenROAD within the design flow allows for efficient serializer optimization and showcases the benefits of utilizing the tool in achieving high-quality designs.

In summary, this research paper focuses on the importance of efficient serializer design and the utilization of the OpenROAD tool in achieving optimized serializer designs. The paper aims to address the challenges associated with serializer design by exploring strategies for enhancing performance, minimizing power consumption, and optimizing area utilization. By implementing a serializer design using OpenROAD and analyzing the results, this research aims to contribute valuable insights to the field of digital integrated circuit design. The findings of this study will shed light on the effectiveness of OpenROAD in the design process and provide practical guidance for designers seeking to achieve efficient serializer designs.

2. Background and Motivation

Serializers play a vital role in digital communication and data processing by converting parallel data streams into a serial format. This conversion is made possible by analog-to-digital converters (ADCs), which transform real-world analog signals into their digital counterparts, laying the foundation for serializer operation. Once the data is digitized, serializers take center stage, transforming parallel data, typically in the form of bits, into a serial stream. This conversion enables efficient transmission and utilization of limited bandwidth channels, making serial data well-suited for long-distance transmission and more effective processing by systems-on-a-chip (SoCs) and other digital devices. Figure 1 illustrates this concept. By employing serializers, digital systems can optimize bandwidth utilization, streamline data transmission, and enable high-speed communication. The serialized data can be further processed, analyzed, and utilized by various components within a larger digital system, opening up a wide range of applications in telecommunications, networking, data storage, and more.

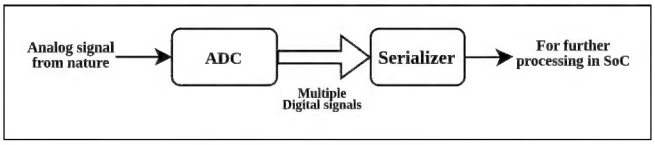

Figure 1: Use of Serializer in SoC

The motivation behind this research paper is to investigate the effectiveness and benefits of OpenROAD, an open-source framework for digital integrated circuit design, in achieving efficient serializer designs within the RTL to GDS flow. OpenROAD provides a comprehensive suite of tools and methodologies for placement, routing, optimization, and timing closure, offering potential advantages in terms of performance, power consumption, area utilization, and design productivity. The findings of this research will contribute to the growing body of knowledge in the field of digital integrated circuit design and provide insights into utilizing OpenROAD for efficient serializer design within the RTL to GDS flow.